

## CLAIMS

We claim:

1. A method of designing a screw for use in injection molding or extrusion  
5 which screw comprises a screw shaft having a thread spirally positioned about the screw shaft so as to form a plurality of flights, and said screw having a feeding zone, a compression zone and a metering zone, comprising the steps of  
selecting the material to be used in the screw,  
selecting the diameter of the screw,  
10 selecting the depth and pitch of a flight in the metering zone to provide a volume of a flight in the metering zone,  
selecting a depth and pitch of a flight in the feeding zone based upon the volume of a flight in the feeding zone needed to provide substantially the same mass of material as is present in a flight in the metering zone.  
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2. The method of claim 1, further comprising the step of selecting the depth and pitch of a flight in the feeding zone such that the depth does not exceed 20% of the diameter of the screw.
- 20 3. The method of claim 1, further comprising the step of adjusting the depth and pitch of the flights in the feeding zone so as to give a compression ratio which is about 25% greater than the ratio of the melt density to the bulk density of the material.
- 25 4. The method of claim 1, further comprising the step of adjusting the depth and pitch of the flights in the feeding zone so as to give a compression ratio which is about 10% greater than the ratio of the melt density to the bulk density of the material.
- 30 5. A method of designing a screw for use in injection molding or extrusion which screw comprises a screw shaft having a thread spirally positioned about the screw shaft so as to form a plurality of flights, and said screw having a feeding zone, a compression zone and a metering zone, comprising the steps of  
selecting the depth and pitch of the flights based upon the material to be  
35 used in the screw so that the difference in the ratio of the actual volumetric flow to the theoretical volumetric drag flow of material in the feeding zone and the ratio of the actual volumetric flow to the theoretical volumetric drag flow of material in

the metering zone is less than 0.2.

6. The method of claim 5, further comprising the steps of  
selecting the material to be used in the screw,  
5 selecting the diameter of the screw,  
selecting the depth of a flight in the metering zone,  
selecting a rotating speed for the screw,  
calculating the pitch of the flight in the metering zone,  
calculating the theoretical volumetric drag flow of material in the metering  
10 zone,  
calculating the theoretical volumetric drag flow of material in the feeding  
zone by multiplying the theoretical volumetric drag flow of material in the  
metering zone by the ratio of the melt density to the bulk density of the material,  
selecting the depth or the pitch of a flight in the feeding zone based upon  
15 the theoretical volumetric drag flow of material in the feeding zone and then  
calculating the value of the depth or pitch, whichever was not selected.

7. The method of claim 6, comprising the step of calculating the theoretical  
drag flow of material in the feeding zone by multiplying the theoretical drag flow  
20 of material in the metering zone by up to 125% of the ratio of the melt density to  
the bulk density of the material.

8. A screw comprising a screw shaft having a thread spirally positioned about  
the screw shaft so as to form a plurality of flights, said screw having a feeding  
25 zone, a compression zone and a metering zone, and means in said screw for  
providing a mass of material in a flight in the feeding zone that is substantially the  
same as the mass of material in a flight in the metering zone, wherein said means  
includes flights formed in the metering zone having a pitch and depth based upon  
the volume of the material in a molten state and flights formed in the feeding zone  
30 having a pitch and depth based upon the volume of the material in a bulk state.

9. In a screw comprising a screw shaft having a thread spirally positioned  
about the screw shaft so as to form a plurality of flights, said screw having a  
35 feeding zone, a compression zone and a metering zone, wherein the pitch of at  
least a portion of the flights in the metering zone is greater than the pitch of at  
least a portion of the flights in the feeding zone, the pitch of at least a portion of

the flights in the feeding zone is less than the outside diameter of the screw, the pitch of at least a portion of the flights in the metering zone is greater than the outside diameter of the screw, the pitch of at least a portion of the flights increases through the compression zone, and the depth of at least a portion of the flights decreases through the compression zone moving from nearer the feeding zone to nearer the metering zone,

wherein the improvement comprises that the depth and pitch of the flights are selected based upon the material to be used in said screw so that the mass of material in a flight in the feeding zone is substantially the same as the mass of material in a flight in the metering zone.

10. A screw comprising a screw shaft having a thread spirally positioned about the screw shaft so as to form a plurality of flights, said screw having a feeding zone, a compression zone and a metering zone, means in said screw for providing a difference in the ratio of the actual volumetric flow of material to the theoretical volumetric drag flow of material in the feeding zone and the ratio of the actual volumetric flow of material to the theoretical volumetric drag flow of material in the metering zone is less than 0.2, wherein said means includes flights formed in the screw such that the pitch of at least a portion of the flights in the metering zone is greater than the pitch of at least a portion of the flights in the feeding zone, the pitch of at least a portion of the flights in the feeding zone is less than the outside diameter of the screw, the pitch of at least a portion of the flights in the metering zone is greater than the outside diameter of the screw, the pitch of at least a portion of the flights increases through the compression zone, and the depth of at least a portion of the flights decreases through the compression zone moving from nearer the feeding zone to nearer the metering zone.

11. The screw of claim 10, wherein the pitch of the flights in the metering zone is greater than the pitch of the flights in the feeding zone, the pitch of the flights in the metering zone is approximately equal, the pitch of the flights in the feeding zone is less than the outside diameter of the screw, the pitch of the flights in the feeding zone is approximately equal, the pitch of the flights in the metering zone is greater than the outside diameter of the screw, the depth of the flights in the metering zone is approximately equal; the depth of the flights decreases through the compression zone moving from nearer the feeding zone to nearer the metering zone; and the depth of the flights in the feeding zone is approximately equal.

12. An injection molding machine which includes the screw of any of claims  
8-11

5 13. An extruder which includes the screw of any of claims 8-11.

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